

Application No.: 09/517,314

Docket No.: M4065.0223/P223

REMARKS

This application has been carefully reviewed in light of the Office Action mailed on July 14, 2003. Claims 1, 11, 13-17, 25, and 39 have been amended. Applicant respectfully requests reconsideration of the above-referenced application in light of the amendments and following remarks.

Independent claim 11 has been amended to recite in pertinent part, "a polymer layer formed over at least a portion of said etch-stop layer," and independent claim 25 has been amended in pertinent part to recite "a polymer layer comprising carbon formed over at least a portion of said etch-stop layer." Support is found in Applicant's specification, pg. 6, line 18 through pg. 7, line 2.

Claims 1, 3-4 and 9-10 stand rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Fig. 11 of Chiang in view of Fig. 9 of Chiang. This rejection is respectfully traversed.

Claim 1 recites a semiconductor device comprising, "an insulator layer, a conductive plug . . . formed of a single conductive material, an etch-stop layer . . . a non-conductive layer having an etched via . . . wider in diameter than said conductive plug, and a conductive connector . . . including a first conductive layer . . . and a second conductive layer." (emphasis added). Chiang does not teach or suggest the limitations found in claim 1. In particular, Chiang does not teach or suggest a polymer layer formed over the etch-stop layer.

The Office Action contends that Fig. 11 discloses Applicant's invention except for a first and second conductor layer. To rectify this deficiency, the Office Action asserts that Fig. 9 of Chiang teaches a first and second conductor layer. However, it is illogical to combine Chiang's Fig. 9 with Fig. 11.

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Chiang discloses that “FIGS. 10 and 11 illustrate an alternate embodiment of the present invention.” (Col. 11, lines 12-13) (emphasis added). Fig. 11 is an alternate embodiment which merely teaches and suggests a single conductor layer provided with a single conductive plug and not “a first conductive layer . . . and a second conductive layer,” as recited in claim 1. Fig. 11 teaches using aluminum as the interconnect material with the associated structure (Col. 11, lines 19-31), whereas FIG. 9 is directed to providing a copper interconnect material (61) that is surrounded by a diffusion barrier layer (60) (FIG. 9). There is no motivation to combine the two figures since they are directed to providing alternate embodiments employing different interconnect materials.

The Office Action contends that “it is conventional to use copper (Cu) layer with barrier layer as a conductive interconnection layer instead of aluminum (Al).” (Office Action, pg. 2) (emphasis added). Applicant respectfully disagrees. Chiang specifically teaches that “[c]opper is typically not used as an interconnect material [and] [a]lthough copper has a relatively low cost and low resistivity, it has a relatively large diffusion coefficient into silicon dioxide and silicon.” (Col. 2, lines 49-52) (emphasis added). As a result, there is no motivation to combine Chiang’s two alternate embodiments depicted in FIG. 9 and FIG. 11.

Applicants respectfully submit that the combination of the Fig. 9 and 11 embodiments is an impermissible hindsight reconstruction of the invention.

Claims 3-4, and 9-10 depend from and contain all of the limitations of claim 1. Accordingly, claims 3-4 and 9-10 are allowable for at least the reasons set forth above for allowance of claim 1.

Claims 5-6 stand rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Chiang in view of Wang. Claims 5-6 depend from and contain all of the limitations of claim 1. Accordingly, claims 5-6 are allowable for at least the reasons given above for allowance of claim 1. Specifically, Chiang does not teach or suggest a first and second conductive layer formed over a conductive plug formed of a single conductive

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material. Wang adds nothing to rectify the deficiencies of Chiang. Withdrawal of the § 103(a) with regard to claims 5-6 is respectfully solicited.

Moreover, Chiang does not teach or suggest that the “etch-stop layer comprises silicon nitride and silicon carbide,” as recited in claim 6 (emphasis added). This is an additional reason for the allowance of claim 6.

Claims 7-8 stand rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Chiang in view of Hong. Claims 7-8 depend from and contain all of the limitations of claim 1. Accordingly, claims 7-8 are allowable for at least the reasons given above for allowance of claim 1. Specifically, Chiang does not teach or suggest a first and second conductive layer formed over a conductive plug formed of a single conductive material. Hong adds nothing to rectify the deficiencies of Chiang. Withdrawal of the § 103(a) with regard to claims 7 and 8 is respectfully solicited.

Claims 11, 15-17, 25, 27, 30-32, and 39 stand rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Chiang’s FIG. 11 in view of FIG. 9 and further in view of Matsuura. Reconsideration is respectfully requested.

As discussed above, there is no motivation to combine Chiang’s FIG. 11 with FIG. 9 since the embodiment taught in FIG. 11 is an alternate embodiment. Copper was not typically used as an interconnect material even though it possessed a lower resistivity than aluminum.

Moreover, Chiang does not teach or suggest, “a conductive plug . . . an etch-stop layer . . . a polymer layer formed over at least a portion of said etch-stop layer, an intermediate non-conductive layer . . . having at least a first and second etched via over said plug . . . and a first conductive layer . . . and a second conductive layer,” as recited in claim 11 (emphasis added), nor a “a conductive plug. . . an etch-stop layer . . . a polymer layer comprising carbon formed over at least a portion of said etch-stop layer, an intermediate non-conductive layer . . . having at least a first and second etched via over said

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plug, said first etched via being wider in diameter than said conductive plug, wherein said second etched via is above and has a greater diameter than said first etched via and . . . a conductive connector comprising a first conductive layer. . . and a second conductive layer,” as recited in claim 25 (emphasis added).

Moreover, the combination of Chiang and Matsuura is improper. There is no motivation to have a first and second etched via over a single conductive plug. Chiang merely suggests that “more than one level of interconnects as shown in FIG. 9,” can be formed (Col. 10, lines 50-52). Chiang does not teach or suggest “an intermediate non-conductive layer . . . having at least a first and second etched via over said plug, said first etched via being wider in diameter than said conductive plug, wherein said second etched via is above and has a greater diameter than said first etched via,” as recited in claims 11 and 25.

The Office Action argues that the Fig. 11 of Chiang would be modified for a smaller line width “by replacing the aluminum interconnection with copper/barrier interconnection in order to provide smaller interconnection because copper layer has a lower resistive than aluminum layer.” (Office Action, pg. 2) (emphasis added). Therefore, there is no motivation to combine Matsuura with Chiang since a wider interconnect structure results. The presence of a first and second etched via larger than the first via would increase the line width of the interconnect.

As discussed above, one of the benefits of Chiang’s invention is that “the interconnects of the present invention can be the same width at the contact region.” (Col. 10, lines 36-37). There is no motivation to form an interconnect channel that is wider when Chiang teaches that a benefit of the invention is increased scaling ability. That is, the combination proposed is directly contrary to the result sought by Chiang.

Claims 15-17 depends from and contains all of the limitations of claim 11, and claims 27, 30-32, and 39 depend from and contain all of the limitations of claim 25. Accordingly, claims 15-17 are allowable for at least the reasons set forth above for

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allowance of claim 11, and claims 27, 30-32, and 39 are allowable for at least the reasons set forth above for allowance of claim 25.

Claims 13-14 and 28-29 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Chiang in view of Matsuura. Claims 13-14 depend from and contain all of the limitations of claim 11. Similarly, claims 28-29 depend from and contain all of the limitations of claim 25. Accordingly, claims 13-14 and claims 28-29 are allowable for at least the reasons given above for allowance of claims 11 and 25 provided above. In particular, Chiang and Matsuura are not properly combinable, and even if they are, the cited references do not teach or suggest "a polymer layer formed over at least a portion of said etch-stop layer," as recited in independent claim 11 or "a polymer layer comprising carbon formed over at least a portion of said etch-stop layer," as recited in independent claim 25.

Accordingly, there are several important features of claims 1, 3-11, 13-17, 25, 27-32, and 39 that are not taught anywhere in the cited prior art. Accordingly, the rejection of claims 1, 3-11, 13-17, 25, 27-32, and 39 should be withdrawn. Allowance of the application with claims 1, 3-11, 25, 27-32, and 39 is respectfully solicited.

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Respectfully submitted,

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